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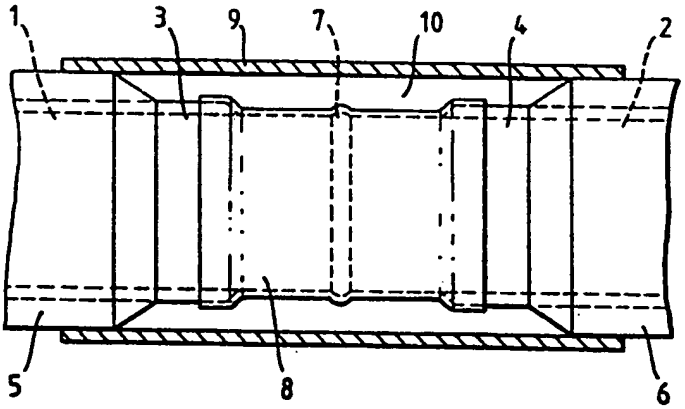
(54) Protection of joints in elongate substrates.

(57) A casing for a joint between weight coated pipes that are to be laid in seawater. The casing surrounds bared portion at the joint, thereby preventing anker-foulage of the joint. Each end of the casing is sealed to the weight coating on respective pipes, and the casing has at least one port of entry to allow flow of seawater into casing. The inflow of seawater, if combined with a sacrificial anode, prevents corrosion of the bared joint.

Fig. 2.



EP 0 272 075 A1

PROTECTION OF JOINTS IN ELONGATE SUBSTRATES

This invention relates to the protection of joints in elongate substrates and more particularly to the protection of welded joints in submerged, weight-coated pipelines.

Submerged weight-coated pipelines are usually installed by a purpose-built offshore vessel known as a laybarge. In a typical operation, twelve metre long steel pipes are coated onshore with an anti-corrosion coating, for example, coaltar enamel, asphalt, or a fusion-bonded epoxy coating, leaving a bare section at each end of the pipe to allow subsequent welding of adjacent lengths to take place without contamination or coating damage. This bare area normally extends up to 250 mm from each end of the pipe. In the next stage, the weight coating, which is usually a mixture of concrete and iron oxide, is applied over the anti-corrosion coating to a thickness of from about 25 mm to about 150 mm, depending upon the degree of negative buoyancy required. The weight coating is also cut-back from the pipe ends to expose the bare section of pipe and about 200 mm of the anti-corrosion coating, in order to allow subsequent overlap and completion of weld area corrosion protection.

On the laybarge the coating pipes are strung together, aligned, welded, and the welds x-ray inspected. An anti-corrosion layer is then applied over the welded region which may, for example be a sealant-coated tape, but is preferably a heat-recoverable wraparound sleeve, such as that sold by Raychem Corporation under the trade mark Thermofit WPC™. Finally the joint area is mechanically protected, to restore the weight coating at the joint, and to protect the joint from mechanical damage during subsequent operations.

Typically the laybarge is divided into a number of work stations each carrying-out a specific function at a pipe joint area. The completed pipelines leaves the rear of the laybarge and encounters a series of rollers and guides which assist, correct and control entry of the pipeline into the sea, river or lake. This collection of rollers and guides, known as the stinger, is towed along by the laybarge and is subjected to any sea movements or wave impacts, hence the pipeline supported by the stinger is itself buffeted about and impacts with the rollers and guides, particularly in rough weather. Such impacts can be severe and could result in damage to the joint area weight coating and exposed anti-corrosion coating if no mechanical protection system were to be employed.

Owing to the high cost of operating a fully equipped laybarge all operations must be carried-out quickly and efficiently, with no single station taking more than 8 minutes to complete its elected task. Various mechanical protection systems for welded pipe joints have been proposed and are commercially available. The most common system involves the use of hot marine mastic, an asphalt/bitumen based material reinforced with aggregate. This marine mastic, which is normally supplied in blocks which have first to be broken up, is fed into a large heated hopper and maintained at a temperature between 180°C and 240°C, at which the marine mastic is in a molten/fluid state. The hopper is positioned at the last working station on the laybarge, directly above the pipeline joint. A single, flat metal sheet is wrapped around the joint area, overlapping the adjacent weight coating, and onto itself to form a mould. Steel straps are attached to the mould and tightened to hold the mould in place. The hot marine mastic from the hopper is introduced through a hole cut in the top of the sheet mould and fills up the annulus formed by the mould. The hole is then sealed by means of a metal sheet that is held in place by means of straps.

The marine mastic system has many disadvantages, namely:-

-Storage and handling of marine mastic blocks, sheet steel and gas (for heating), and breaking of the mastic blocks occupies valuable laybarge space and requires handling personnel.

-Heating of marine mastic takes time and temperature control requires careful monitoring. If too cold it will not flow properly, if too hot it can damage certain types of corrosion protection materials used at the weld area.

-The hot marine mastic gives off smoke and harmful fumes.

-Should the hot marine mastic come into contact with the skin, severe burns will result.

-Marine mastic often leaks from the sides of the mould due to inadequate tightening of the steel straps. Hence the mould will not fill-up completely.

-As the marine mastic takes considerable time to cool down to a solid state, its impact resistance is not fully developed by the time the joint is exposed to stinger forces. Forced cooling using sea water is often necessary.

-Should the X-ray inspection film of a weld indicate a flaw within the weld that requires repair,

marine mastic may already have been poured. In this case the joint area is difficult to re-enter and clean-up.

-After the pipeline has been laid on the sea bed, any damaged or corroded metal casing can present problems for fishing nets.

Another mechanical protection system for joints which is available involves the use of polymer-cement in-fill systems instead of hot marine mastic. Yet another system uses special liquids that foam-up to fill in the annular space between pipe and mould. Again special chemicals must be correctly stored and then mixed using sophisticated application equipment requiring skilled operators.

It has long been recognised that there is a need for a joint protection system which obviates the deficiencies of the known techniques. We have now discovered a system in which the function of mechanical protection is fulfilled by a hollow enclosure and the weight coating comprises a fluid.

According to one aspect of the present invention there is provided a method of protecting a joint in a weight-coated elongate substrate which comprises surrounding the joint with a hollow enclosure, securing the enclosure to the elongate substrate so that an annular enclosed space is formed around the joint region, there being at least one port for the entry of fluid into the annular enclosed space, and submerging at least the joint region of the weight-coated elongate substrate into a fluid so that the fluid enters and substantially fills the annular enclosed space.

In another aspect the invention provides a joint in a weight-coated elongate substrate which is provided with a surrounding hollow enclosure secured to the elongate substrate so as to form an annular enclosed space around the joint region, there being at least one port for the entry of fluid into the annular enclosed space, and the joint region being immersed in a fluid so that the fluid enters and substantially fills the annular enclosed space.

The invention will now be more specifically described with respect to joints in submarine pipelines although it is to be understood that it is not limited thereto and may for example be applicable to submarine cables and other submerged or buried structures.

The surrounding hollow enclosure preferably comprises a pair of rigid, semi-cylindrical half-shells, although a wraparound sleeve may possibly be used in less demanding situations. The half-shells are preferably formed from a non-corrodable material and should be able to withstand the mechanical forces to which the joint region will be exposed. Suitable materials for the half-shells include, for example polymer materials such as polyethylene, polypropylene, polyester, polyamide or epoxy material, which may be reinforced with for example glass fibres as required.

Preferably the half-shells are of an internal diameter such that they fit snugly over the weight coating on each side of the joint region, and of a length such that they overlap the weight coating by from about 50 to 150 mm. The wall thickness of the half-shells will depend to some extent on the material and the pipeline diameter, but will usually be from 10 to 30 mm, preferably about 20 mm.

The half-shells may be secured to the adjacent pipeline weight coating by suitable mechanical devices, for example straps or tie-wraps, but preferably they are secured by means of heat recoverable sleeves, which are shrunk down over the end regions of the half-shells and the adjacent weight coating. The sleeves, which are preferably internally coated with a sealing material, preferably an adhesive such as a hot melt adhesive or a sealant such as a mastic, need to be able to withstand severe mechanical handling and are therefore preferably formed from a heat recoverable fabric. Suitable heat-recoverable fabrics are described in US-3669157, EP-A-115905, EP-A-116390, EP-A-116391, EP-A-116392, EP-A-116393, EP-A-117025, EP-A-117026, EP-A-118260, EP-A-137648, EP-A-153823, EP-A-175554 and European Patent Application no. 86303787.7. A preferred heat-recoverable fabric is that sold by Raychem Corporation under the trade mark Rayfort™. Very good results have been obtained using sleeves formed from Rayfort™ fabric and sold by Raychem Corporation under the trade mark SZART™.

The half-shells may be provided with one or more holes which serve as ports for the entry and exit of a fluid, usually water, in which the pipeline is immersed. However, preferably the half-shells are so constructed that, when placed around the pipe, the longitudinal edges of the half-shells do not quite meet, thus leaving a slot or slots extending for the length of the joint region. Preferably a slot is from 10 to 100mm, and more preferably from 25 to 50 mm in width. An advantage of this arrangement is that it enables the half-shells to accommodate small variations in the diameter of the weight coating of the pipeline, which will merely result in small differences in the width of the slot.

A significant advantage of the use of a non-corroding enclosure in accordance with the invention is that it enables the enclosure to be marked so that divers or mechanical devices inspecting the pipeline can recognise and identify each individual joint.

Thus, in another aspect, the invention provides a joint in a submerged pipeline that is provided with an enclosure having visible or recognisable identification means.

Such means may comprise, for example, a

joint marking patch which preferably comprises a material that resists fouling by marine organisms. A suitable material is copper, and for example the patch may comprise copper identification markings carried on a polymer backing. The backing may be fixed to the enclosure by means of adhesive, or by tying, clamping or magnetic devices. A preferred marking patch comprises copper shapes, for example studs, partially embedded in a surface of a polymer backing sheet, the backing optionally being coated on its opposite surface with an adhesive, preferably a hot melt adhesive. Such marking patches are new articles and are accordingly included with the scope of the invention. The marking patches may have a variety of uses and may be attached to any suitable underwater structure such as platform or rig support legs, pipelines, risers, valves and flanges.

The invention will now be illustrated by way of example with reference to the accompanying Drawings in which:

Figure 1 shows a joint region in side elevation prior to the attachment of the enclosure;

Figure 2 shows the joint region in part sectional side elevation, with the enclosure in position;

Figure 3 shows the joint region in plan view with the enclosure secured to the pipeline; and

Figure 4 shows a joint marking patch in sectional side elevation.

Referring now to the Drawings, the joint region in Figure 1 comprises two steel pipes 1 and 2, having anti-corrosion coatings 3 and 4, and weight coatings 5 and 6. The anti-corrosion coatings and the weight coatings are cut back to expose lengths of bare pipe which are welded at 7. A heat recoverable wraparound sleeve 8 internally coated with a mastic, sold by Raychem Corporation under the trade mark Thermofit WPC™, is shrunk over the weld and overlaps the anti-corrosion coatings on each side of the weld. The wraparound sleeve may be provided with an adhesive patch closure, or a suitable mechanical closure, for example a rail and channel closure. Figure 2 shows the joint with the enclosure 9 in position, leaving an annular space 10 around the joint region. From Figure 3 it can be seen that the enclosure comprises a pair of half-shells 10 and 11 which are sized such that when placed over the joint region a gap 12 is left between their longitudinal edges. The half-shells are secured to the pipes with heat recoverable fabric sleeves 13 and 14, which are sold by Raychem Corporation under the trade mark Rayfort™. The sleeves 13 and 14 are internally coated with a hot-melt adhesive to provide greater shear strength to prevent the casing from sliding along the pipe. The sleeves also round off the edges of the half-shells, thus allowing the enclosure to ride more easily over the rollers of the stinger. Any tightening straps or adhesive tape used to hold and compress the two half-shells together can be left on the casing to assist mechanical strength during the laying operation, if these subsequently corrode or rot away, this will be of no consequence as the heatshrink sleeves will permanently hold the casing in place.

A joint marking patch (or plate) as shown in Figure 4 can be used for identification of any particular joint and can be pre-installed on one shell or installed immediately after recoverable sleeve installation. The marking patch consists of a cross-linked polymer or other plastic sheet 15 into which any number of copper metal studs 16 are embedded with the heads proud of the sheet upper surface. Any desired identification of numbers/letters/symbols can be obtained by installing the copper studs according to the required pattern. During subsea service the copper heads will prevent marine growth attachment and will therefore be permanently visible to divers or subsea inspection vehicles. The under surface of the polymer sheet is precoated with a suitable heat activated adhesive 17 which will bond to the half-shells wall material when the patch is heated (usually by gas torch). For existing subsea constructions or for constructions other than pipeline joints, the identification patch can be installed by tieing, clamping, using contact type adhesives or by incorporating magnetic devices within the polymer matrix which then automatically attach the patch to any steel surface.

As the completed pipeline leaves the laybarge, sea water will enter the joint annulus through the gaps bet ween the two half-shells, expelling all air and thereby adding to the negative buoyancy of the entire pipeline. Furthermore as all sections of the anti-corrosion coating beneath the joint enclosure are now directly in contact with sea water, cathodic protection current from anodes (normally installed on such submarine pipelines) can flow through the gaps 12 directly to any anti-corrosion coating flaws, thereby providing the perfect conditions for effective cathodic protection.

Although the weight of water which fills the joint region will normally be sufficient to provide enough negative or neutral buoyancy, it may on occasions be necessary to fill the joint region with a heavier medium such as sand, gravel, cement, concrete or mastics. In this case the two half-shells can be installed with the bottom joint section closed together, leaving only the top section open to allow entry of such media.

The method of this invention does not require special storage, high temperature melting or handling of hazardous or shelf life sensitive materials. The method requires no mixing or complex equipment in order to complete a fast, easy and high quality installation. Once installed the system can

easily be re-entered should a weld need repair. Within a few minutes after completion the system reaches its maximum mechanical strength prior to contact with the stinger. The system allows cathodic protection current to reach directly any coating flaws and dows not contain any corrodeable metallic parts that could damage fishing nets. Each joint can be permanently marked with an individual identification mark which is unaffected by marine growth or corrosion, thereby allowing a diver to identify any specific joint and also confirm his own position on the sea bed.

Claims

1. A joint in a weight-coated elongate substrate which is provided with a surrounding hollow enclosure secured to the elongate substrate so as to form an annular enclosed space around the joint region, there being at least one port for the entry of fluid into the annular enclosed space, and the joint region being immersed in a fluid so that the fluid enters and substantially fills the annular enclosed space.

2. A joint as claimed in claim 1, in which the enclosure is secured to the elongate substrate by means of a heat shrinkable sleeve.

3. A joint as claimed in claim 2, in which the enclosure comprises a heat shrinkable fabric.

4. A joint as claimed in claim 2 or claim 3, in which the enclosure is coated on the surface facing the substrate with a layer of sealing material.

5. A joint as claimed in any one of claims 1 to 4, in which the port is in the form of a slot extending substantially longitudinally of the enclosure.

6. A method of protecting an uncoated portion of a weight-coated elongate substrate, which comprises surrounding the said portion with a hollow enclosure, securing the enclosure to the elongate substrate so that an annular enclosed space is formed around the uncoated portion, there being at least one port for the entry of fluid into the annular enclosed space, and submerging at least the uncoated portion of the weight-coated elongate substrate into a fluid so that the fluid enters and substantially fills the annular enclosed space.

7. A joint in a submerged pipeline that is provided with an enclosure having visible or recognisable identification means.

8. A marking patch for submerged or submergible articles which comprises an identification means that resists fouling by marine organisms carried on a polymeric backing, and means for attaching the polymeric backing to the submerged or submergible article.

Fig. 1.

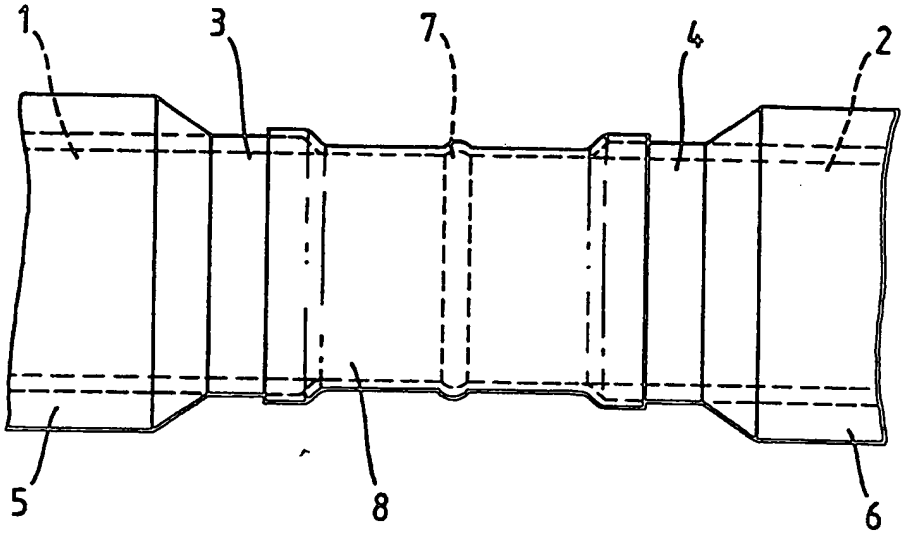


Fig. 2.

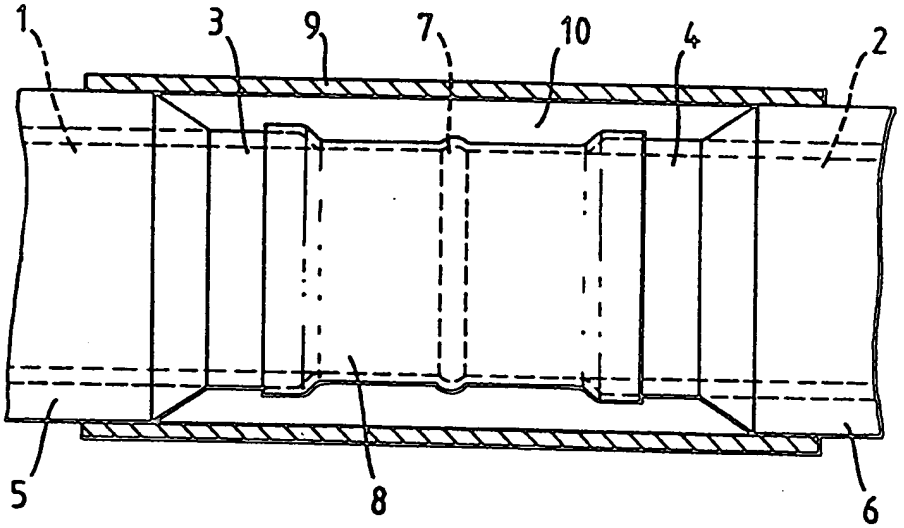


Fig. 3.

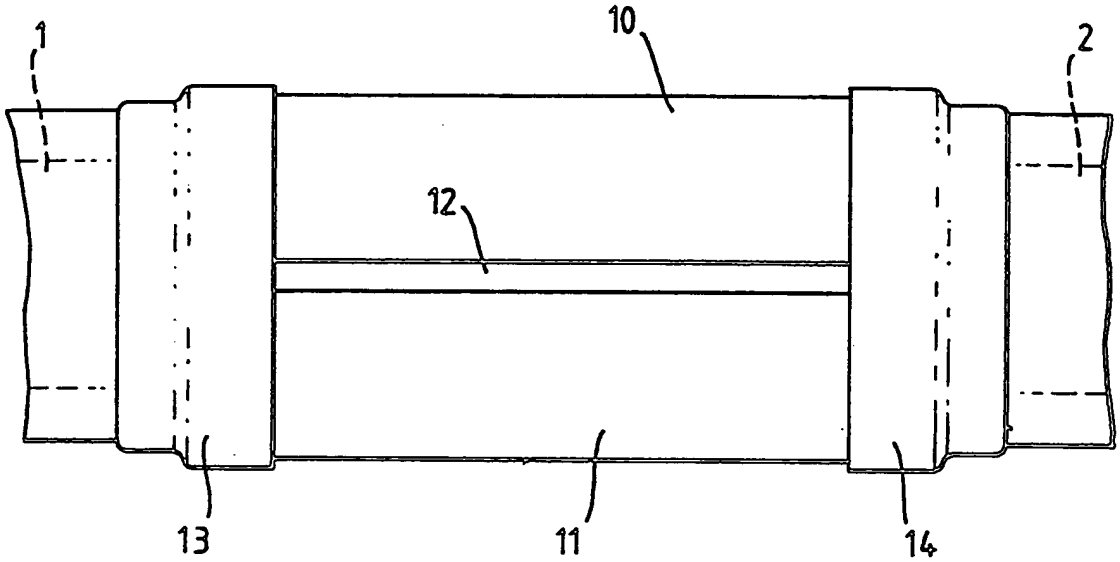
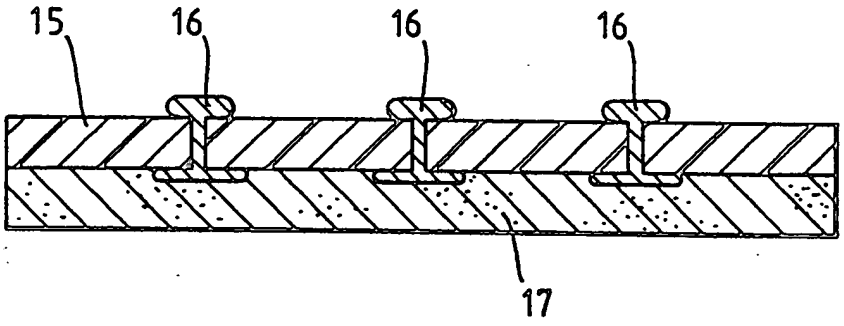


Fig. 4.



European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87311000.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	EP - A1 - 0 079 610 (UBE INDUSTRIES LTD.) * Totality * --	1-4,6	F 16 L 58/00 F 16 L 55/00 F 16 L 1/04
A	FR - A1 - 2 341 811 (SHELL) * Totality * --	1	
A	DD - A - 130 071 (SEVERIN) ----		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 16 L 1/00
F 16 L 13/00
F 16 L 25/00
F 16 L 55/00
F 16 L 58/00
F 16 L 59/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	29-01-1988	SCHUGANICH

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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